- NGST a key component of Origins
- 8 m radiatively-cooled telescope at L2
- High resolution, large field, deep sensitivity, low background
- 10-years of observing to meet astronomers' needs
- Opens door to future affordable observatories

1.0 INTRODUCTION

The Next Generation Space Telescope (NGST) is a key component of NASA's Origins Program. Reflecting major current astrophysics research themes as restated in NASA's Space Science Enterprise strategic plan [1], Origins responds directly to the questions:

- *How did the Universe, galaxies, stars, and planets evolve? How can our exploration of the Universe and our Solar System revolutionize our understanding of physics, chemistry, and biology?*
- *Does life in any form — however simple or complex, carbon-based or other — exist elsewhere in the Universe? Are there Earth-like planets beyond our Solar System?*

AT A GLANCE

Primary Mirror	8m
Wavelength Range	.6-10⁺ μm
Mission Lifetime	5 years, 10-year goal
Passively Cooled	<50 K
Orbit	L2

NGST has been under study since 1995 and is planned to be launched around 2008, nearly 400 years after Galileo discovered the moons of Jupiter, over 60 years after Lyman Spitzer proposed space telescopes, and 50 years after the National Space Act created NASA. The mission is a logical successor to the Hubble Space Telescope (HST), and fits in the context of the other Origins missions: FUSE, SOFIA, SIRTF, SIM, and the Terrestrial Planet Finder and Planet Imager, which are planned or under construction. The schedule for these missions is shown in Fig. 1.1. NGST logically depends on technology developed by SIRTF and HST, and, in turn, future missions will use NGST technology to search for terrestrial-sized planets.

NGST will be an 8 m class deployable, radiatively cooled telescope, optimized for the 1 – 5 μm band, with background limited sensitivity from 0.6 to 10 μm or longer, operating for 10 years near the Earth-Sun second Lagrange point (L2), 1.5 million km from Earth. It will be a general-purpose observatory, operated by the Space Telescope Science Institute (STScI) for competitively selected observers from the international astronomy community. NASA, the European Space Agency (ESA), and the Canadian Space Agency (CSA) will build NGST, with construction to start in 2003. The planned NASA part of the construction budget is $500 M (FY96), but the combined total of NASA, ESA, and CSA contributions, including launch, operations, grants, technology development, and inflation, will be around $2B (in real year dollars). This sum represents about one-quarter the amount invested in HST.

NGST will be a unique scientific tool, with excellent angular resolution over a large field of

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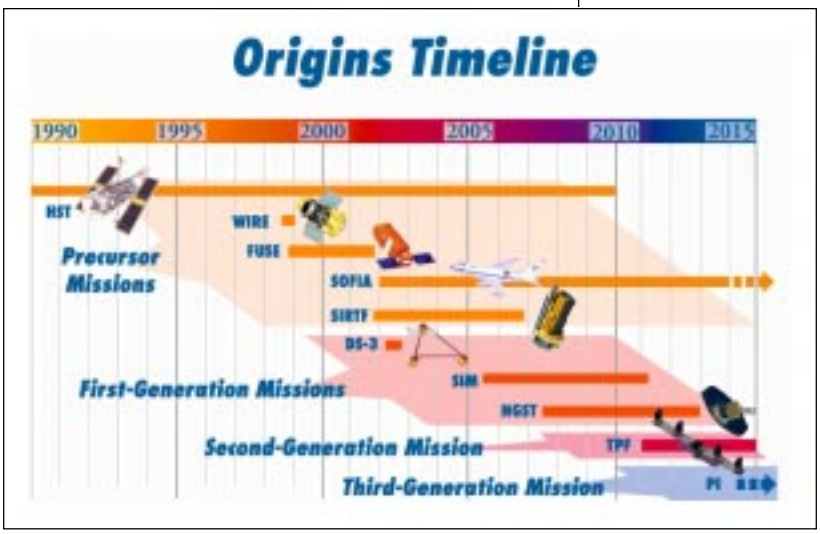

Figure 1.1: The Origins Mission Plan. Each mission builds upon the science and the technologies of its predecessors.

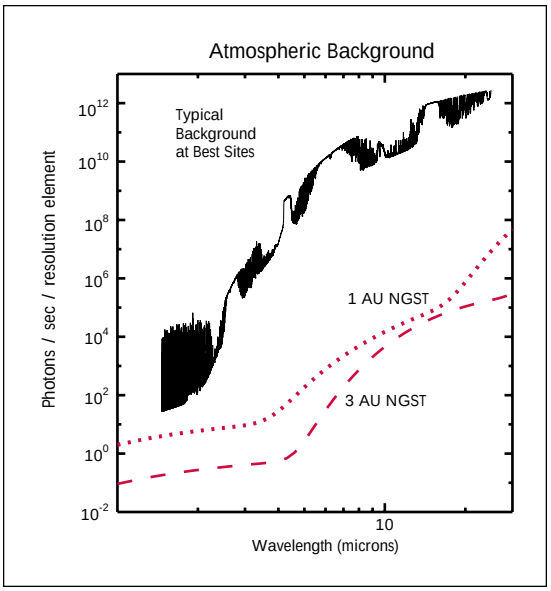

Figure 1.2 NGST takes advantage of the lower infrared background of space. The upper curve shows a model of the atmospheric and telescope backgrounds for Mauna Kea (1 mm water). The two lower curves show the zodiacal background at 1 and 3 AU respectively, with a contribution at longer wavelengths from the 50 K optics.

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view, deep sensitivity and a low-infrared (IR) background. As a cold space telescope, NGST will achieve far better sensitivities than ground-based telescopes. Figure 1.2 [1.2] shows the background levels from Mauna Kea and in space. They differ by one to six orders of magnitude, depending on wavelength. NGST will have diffraction limited resolution at 2 μm or better, and will achieve much higher Strehl ratios and wider fields of view than anticipated from ground-based telescopes using adaptive optics. NGST's aperture is an order of magnitude larger than SIRTF's, with a factor of 100 better sensitivity.

NGST will be able to observe the first generations of stars and galaxies, including individual starburst regions, protogalactic fragments, and supernovae out to redshifts of z = 5 - 20. NGST will resolve individual stars in nearby galaxies, penetrate dust clouds around local star-forming regions, and discover thousands of isolated sub-stellar and Kuiper Belt objects. In 2008, it will be NASA's premier general-purpose observatory, serving the needs of thousands of astronomers and pushing frontier knowledge far beyond the currently known Universe. The NGST design also opens the door for an affordable "product line" of observatories for the future.